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Title: A RECORDING POSITION CORRECTION METHOD, AN INKJET TYPE
RECORDING APPARATUS AND A COMPUTER PROGRAM

TRANSLATION OF PRIORITY DOCUMENT

The undersigned hereby certifies that he well knows both English and Japanese languages, and that the attached is an accurate translation into English of the certified copy(ies) of the following foreign patent application(s).

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[TITLE OF THE INVENTION]

A RECORDING CORRECTION METHOD, AN INKJET TYPE RECORDING APPARATUS
AND A COMPUTER PROGRAM

[WHAT IS CLAIMED IS]

[Claim 1]

A recording correction method for correcting position deviation of a plurality of ejection holes in a sub-scanning direction crossing a main scanning direction, wherein an inkjet type recording apparatus performs recording on said material to be recorded by ejecting ink from said plurality of ejection holes while allowing a recording head, on which said plurality of ejection holes are arranged in said main scanning direction, to perform scanning along at least one of forward and backward paths in said main scanning direction, comprising:

an ejection step of ejecting said ink from said plurality of ejection holes onto said material to be recorded;

a measurement step of measuring an amount of deviation of ejected ink in said sub-scanning direction; and

a correction step of previously shifting and correcting an image to be recorded on said material for each of said plurality of ejection holes based on said measured amount of deviation.

[Claim 2]

A recording correction method as claimed in claim 1, wherein said ink is ejected from two of said ejection holes most distanced from each other in said main scanning direction among said plurality of ejection holes in said ejection step, and

said image to be recorded on said material is previously shifted for each of said plurality of ejection holes based on an amount of deviation of ink ejected from said two ejection holes in said correction step.

[Claim 3]

A recording correction method as claimed in claim 2, wherein said ink is further ejected from a ejection hole among said plurality of ejection holes except said two ejection holes in said ejection

step, and

said image to be recorded on said material is previously shifted for each of said plurality of ejection holes based on an amount of deviation of ink ejected from said two ejection holes and said ejection hole except said two ejection holes in said correction step.

[Claim 4]

A recording correction method as claimed in claim 1, wherein said ink is ejected from said plurality of ejection holes in order that a color of said ink from each of said ejection holes is different from one another in said ejection step, and

said image is previously shifted for each of said colors in said correction step.

[Claim 5]

A recording correction method as claimed in claim 1, wherein said ink is ejected while said recording head performs scanning along said forward and/or backward path(s) in said main scanning direction in said ejection step, and

said image is previously shifted in said correction step based on an intermediate value between an amount of deviation in case said ink is ejected while said recording head performs scanning along said forward path in said main scanning direction and an amount of deviation in case said ink is ejected while said recording head performs scanning along said backward path.

[Claim 6]

A recording correction method as claimed in claim 1, wherein said ink is ejected while said recording head performs scanning along said forward and/or backward path(s) in said main scanning direction in said ejection step, and

in said correction step, said image to be recorded along said forward path in said main scanning direction is previously shifted based on an amount of deviation in case said recording head performs scanning along said forward path in said main scanning direction, and

said image to be recorded along said backward path in said

main scanning direction is previously shifted based on an amount of deviation in case said recording head performs scanning along said backward path in said main scanning direction.

[Claim 7]

A recording correction method as claimed in claim 1, wherein said ink is ejected from two of said plurality of ejection holes which eject said ink of two colors respectively as priority is given to a color of which density is highest in said ejection step, and

said image to be recorded on said material is previously shifted for each of said plurality of ejection holes based on an amount of deviation of ink ejected from said two ejection holes in said correction step.

[Claim 8]

An inkjet type recording apparatus for performing recording on a material to be recorded by ejecting ink from a plurality of ejection holes while allowing a recording head, on which said plurality of ejection holes are arranged in said main scanning direction, to perform scanning along at least one of forward and backward paths in said main scanning direction, comprising:

a correcting unit for previously shifting and correcting an image to be recorded on said material for each of said plurality of ejection holes based on an amount of deviation of said plurality of ejection holes in a sub-scanning direction crossing said main scanning direction.

[Claim 9]

A computer program for correcting deviation of an image caused by deviation of a plurality of ejection holes in a sub-scanning direction crossing a main scanning direction, wherein an inkjet type recording apparatus records said image on said material to be recorded by ejecting ink from said plurality of ejection holes while allowing a recording head, on which said plurality of ejection holes are arranged in said main scanning direction, to perform scanning along at least one of forward and backward paths in said main scanning direction, comprising:

a correction function of previously shifting and correcting said image to be recorded on said material for each of said plurality of ejection holes based on an amount of deviation of ink ejected from said plurality of ejection holes in said sub-scanning direction crossing said main scanning direction.

[DETAILED DESCRIPTION OF THE INVENTION]

[0001]

[Field of the Invention]

This invention relates to a recording correction method, an inkjet type recording apparatus and a computer program. Particularly, the present invention relates to a recording correction method, an inkjet type recording apparatus and a computer program, which capable of making up for the deviation of an image due to the fitting direction of a recording head.

[0002]

[Description of the Related Art]

An inkjet type recording apparatus performs recording on a material to be recorded by ejecting ink from a plurality of ejection holes while allowing a carriage including a recording head on which the ejection holes are arranged in a main scanning direction to perform a scanning operation along at least either a forward or backward path in the main scanning direction.

[0003]

[Problems to be Solved by the Invention]

In the inkjet type recording apparatus, the carriage might be fitted with a guide holding it being tilted to the guide. In addition, since the carriage cannot be fitted with the guide in a good state, the carriage might be shaky when the recording head performs scanning along at least either the forward or backward path in the main scanning direction. Since the recording head cannot be positioned exactly to the material to be recorded in the inkjet type recording apparatus above, it is impossible to perform desired recording.

[0004]

Therefore, it is an object of the present invention to provide

a recording correction method, an inkjet type recording apparatus and a computer program, which can solve the foregoing problems. The above and other objects can be achieved by combinations described in the independent claims. The dependent claims define further advantageous and exemplary combinations of the present invention.

[0005]

[Means for Achieving the Objects]

According to the first aspect of the present invention, a recording correction method for correcting position deviation of a plurality of ejection holes in a sub-scanning direction crossing a main scanning direction, wherein an inkjet type recording apparatus performs recording on the material to be recorded by ejecting ink from the plurality of ejection holes while allowing a recording head, on which the plurality of ejection holes are arranged in the main scanning direction, to perform scanning along at least one of forward and backward paths in the main scanning direction, includes an ejection step of ejecting the ink from the plurality of ejection holes onto the material to be recorded, a measurement step of measuring an amount of deviation of ejected ink in the sub-scanning direction, and a correction step of previously shifting and correcting an image to be recorded on the material for each of the plurality of ejection holes based on the measured amount of deviation.

[0006]

In the ejection step, the ink may be ejected from two of the ejection holes most distanced from each other in the main scanning direction among the plurality of ejection holes, and in the correction step, the image to be recorded on the material may be previously shifted for each of the plurality of ejection holes based on an amount of deviation of ink ejected from the two ejection holes. In the ejection step, the ink may be further ejected from a ejection hole among the plurality of ejection holes except the two ejection holes, and in the correction step, the image to be recorded on the material may be previously shifted for each of

the plurality of ejection holes based on an amount of deviation of ink ejected from the two ejection holes and the ejection hole except the two ejection holes. In the ejection step, the ink may be ejected from the plurality of ejection holes in order that a color of the ink from each of the ejection holes is different from one another, and in the correction step, the image may be previously shifted for each of the colors.

[0007]

In the ejection step, the ink may be ejected while the recording head performs scanning along the forward and/or backward path(s) in the main scanning direction, and in the correction step, the image may be previously shifted based on an intermediate value between an amount of deviation in case the ink is ejected while the recording head performs scanning along the forward path in the main scanning direction and an amount of deviation in case the ink is ejected while the recording head performs scanning along the backward path. In the ejection step, the ink may be ejected while the recording head performs scanning along the forward and/or backward path(s) in the main scanning direction, and in the correction step, the image to be recorded along the forward path in the main scanning direction may be previously shifted based on an amount of deviation in case the recording head performs scanning along the forward path in the main scanning direction, and the image to be recorded along the backward path in the main scanning direction may be previously shifted based on an amount of deviation in case the recording head performs scanning along the backward path in the main scanning direction. In the ejection step, the ink may be ejected from two of the plurality of ejection holes which eject the ink of two colors respectively as priority is given to a color of which density is highest, and the image to be recorded on the material may be previously shifted for each of the plurality of ejection holes based on an amount of deviation of ink ejected from the two ejection holes in the correction step.

[0008]

According to the second aspect of the present invention,

an inkjet type recording apparatus for performing recording on a material to be recorded by ejecting ink from a plurality of ejection holes while allowing a recording head, on which the plurality of ejection holes are arranged in the main scanning direction, to perform scanning along at least one of forward and backward paths in the main scanning direction, includes a correcting unit for previously shifting and correcting an image to be recorded on the material for each of the plurality of ejection holes based on an amount of deviation of the plurality of ejection holes in a sub-scanning direction crossing the main scanning direction.

[0009]

According to the second aspect of the present invention, a computer program for correcting deviation of an image caused by deviation of a plurality of ejection holes in a sub-scanning direction crossing a main scanning direction, wherein an inkjet type recording apparatus records the image on the material to be recorded by ejecting ink from the plurality of ejection holes while allowing a recording head, on which the plurality of ejection holes are arranged in the main scanning direction, to perform scanning along at least one of forward and backward paths in the main scanning direction, includes a correction function of previously shifting and correcting the image to be recorded on the material for each of the plurality of ejection holes based on an amount of deviation of ink ejected from the plurality of ejection holes in the sub-scanning direction crossing the main scanning direction.

[0010]

The summary of the invention does not necessarily describe all necessary features of the present invention. The present invention may also be a sub-combination of the features described above.

[0011]

[Preferred Embodiments of the Invention]

The invention will now be described based on the preferred embodiments, which do not intend to limit the scope of the present invention, but exemplify the invention. All of the features and

the combinations thereof described in the embodiment are not necessarily essential to the invention.

[0012]

It is an object of a recording correction method, an inkjet type recording apparatus and a computer program according to the present embodiment to make up for the recording error that occurs due to the fitting error or looseness of the recording head in order to records an image as closely as in a way that a user's desires.

[0013]

Fig. 1 is a side view schematically showing the inner configuration of an inkjet type recording apparatus. Here, the inkjet type recording apparatus 10 is an example of a liquid ejecting apparatus. In addition, a recording head of the inkjet type recording apparatus 10 is an example of a liquid ejecting head of the liquid ejecting apparatus. Ejection holes provided on the recording head are an example of ejecting openings of the liquid ejecting head. In addition, a material to be recorded 11 is an example of a target.

[0014]

However, the inkjet type recording apparatus is not limited to this embodiment. As another example of the liquid ejecting apparatus, there is a color filter manufacturing apparatus for manufacturing a color filter of a liquid crystal display. In this case, a color material ejecting head of the color filter manufacturing apparatus is an example of the liquid ejecting head. Further another example of the liquid ejecting apparatus is an electrode forming apparatus for forming electrodes such as an organic EL display, a FED (Field Emission Display) or the like. In this case, an electrode material (conduction paste) ejecting head of the electrode forming apparatus is an example of the liquid ejecting head. Further another example is a biochip manufacturing apparatus for manufacturing biochips. In this case, a bio organism ejecting head of the biochip manufacturing apparatus and a sample ejecting head as a minute pipette are examples of the liquid ejecting

head. The liquid ejecting apparatus of the present invention includes other liquid ejecting apparatuses used for industrial purposes.

[0015]

The inkjet type recording apparatus 10, as shown in Fig. 1, includes a placement unit 12 for holding a plurality of materials to be recorded 11, a feeding unit 20 for taking one material to be recorded 11 out of the placement unit 12 and feeding it in order to perform printing, a transferring unit 30 for transmitting power to the material to be recorded 11 fed by the feeding unit 20 in a feeding direction, a printing unit 40 for performing printing on the material to be recorded 11 and a discharging unit 50 for transmitting power to the material 11 on which printing is finished in a discharge direction, along the feeding order.

[0016]

The feeding unit 20 includes a paper feeding roller 22 and a separation pad 24 which are rotated by a motor, not shown, together with a driving shaft. The paper feeding roller 22 is substantially the shape of a fan, and the driving shaft 26 is provided at the center of an arc that is a part of the fan. As the paper feeding roller 22 is rotated, the paper feeding roller 22 repeats contact and separation states with and from the separation pad 24. In the contact state, the paper feeding roller 22 and the separation pad 24 separate the materials to be recorded 11 piled on the placement unit 12 one by one by holding a material to be recorded 11 placed on the top of the pile between the paper feeding roller 22 and the separation pad 24, and feed it to the transferring unit 30. During this feeding process, the paper feeding roller 22 and a hopper that is a part of the placement unit 12 are separated from each other in order to put the material 11 on which recording has not been performed back to the placement unit 12 for arrangement.

[0017]

The transferring unit 30 includes a transferring roller 32 that is rotated by a motor 60 and a transfer driven roller 34 that is rotated accompanying the transferring roller 32, so that it

transfers the material to be recorded 11 fed by the feeding unit 20 toward a lower part of the printing unit 40 by holding the material to be recorded 11 at a contact point between the transferring roller 32 and the transfer driven roller 34.

[0018]

The printing unit 40 includes a carriage 42 in which an ink cartridge is mounted, a recording head 44 provided on a surface, which faces the material to be recorded 11, of the carriage 42 for ejecting ink, an engaging part 46 provided on the carriage 42, a guide 48 engaged with the engaging part 46 for supporting the carriage 42 to slide freely along at least either a forward or backward path in a main scanning direction substantially perpendicular to the feeding direction and a controlling unit 49 for controlling printing. Here, a sub-scanning direction is defined as the feeding direction of the material to be recorded 11. The controlling unit 49 controls printing by controlling the printing unit 40 and the transferring unit 30 in accordance with image data received from an information processing apparatus 300 such as a computer. Further, the recording head 44 includes a plurality of ejection holes being arranged along the main scanning direction of the carriage 42.

[0019]

The discharging unit 50 includes a discharging roller 52 that is rotated by the motor 60 and a discharge driven roller 54 rotated accompanying the discharging roller 52, so that it discharges the material 11 after printing by holding the material 11 at a contact point between the discharging roller 52 and the discharge driven roller 54.

[0020]

Further, the transfer driven roller 34 is provided above the transferring roller 32 and biased towards the recording head 44 compared with the transferring roller 32, and the discharge driven roller 54 is provided above the discharging roller 52 and biased towards the recording head 44 compared with the discharging roller 52. Therefore, the material to be recorded 11 is bent

downwards at a position facing the printing unit 40.

[0021]

In the configuration described above, the inkjet type recording apparatus 10 ejects ink while reciprocating the recording head 44 along the guide 48. The inkjet type recording apparatus 10 performs recording for all of the materials to be recorded 11 by feeding them at each time the recording head 44 performs the scanning operation. Further, the recording head 44 may perform printing for both forward and backward paths or may perform for either of them.

[0022]

Further, the transferring unit 30 and the discharging unit 50 are supplied with the power transmitted from the motor 60 via a belt 62. The belt 62 is applied with tension by a tensioner 64. The motor 60, the tensioner 64, the transferring unit 30 and the discharging unit 50 are arranged in line along a direction in which the belt 62 flows.

[0023]

Fig. 2 shows an example of functional blocks of a controlling unit 49. The controlling unit 49 includes an image data storing unit 440, a correcting unit 430, a correction amount storing unit 420, a correction data storing unit 450 and a correction data outputting unit 400.

[0024]

The image data storing unit 440 acquires and stores image data of the image to be recorded on the material 11 from the information processing apparatus 300. The correction amount storing unit 420 stores a correction amount for correcting the image data, if the ejection holes arranged on the recording head 44 deviate in the sub-scanning direction. The correction amount of the image data is calculated based on the deviation of the ejection holes in the sub-scanning direction.

[0025]

The correcting unit 430 acquires the image data from the image data storing unit 440 and acquires the correction amount

of the image data from the correction amount storing unit 420. Further, the correcting unit 430 corrects the image data by shifting the image data in advance in regard to each of the ejection holes based on the correction amount acquired from the correction amount storing unit 420 and stores it into the correction data storing unit 450. The correction data outputting unit 400 acquires the image data corrected from the correction data storing unit 450, and outputs it to the transferring unit 30 and the printing unit 40. Therefore, the transferring unit 30 and the printing unit 40 record the corrected image data on the material to be recorded 11.

[0026]

In addition, as further another modification, a recording medium 700, in which a computer program for operating the image data storing unit 440, the correcting unit 430, the correction amount storing unit 420, the correction data storing unit 450 and the correction data outputting unit 400 is stored, may be installed in the information processing apparatus 300 and the information processing apparatus 300 may correct the image data based on the computer program stored in the recording medium 700. The recording medium 700 may be distributed as utility software. In addition, as another modification, the information processing apparatus 300 may acquire the computer program for operating those units via a communications line.

[0027]

In this way, the controlling unit 49 corrects the image data by shifting the image to be recorded on the material 11 in advance based on the amount of the deviation in the sub-scanning direction of a plurality of ejection holes. Therefore, in comparison to a case that correction is performed while the carriage 42 is fitted with the guide 48, in the present embodiment, it is possible to easily correct the amount of the deviation of a plurality of ejection holes in the sub-scanning direction. Further, according to the present embodiment, it is not necessary that correction is performed while the carriage 42 is fitted with the guide 48, so

that the number of parts of the inkjet type recording apparatus 10 can be reduced.

[0028]

Fig. 3(a) and 3(b) are bottom views of the carriage 42 on which the recording head 44 is provided. Fig. 3(a) shows a bottom view of the carriage 42 including a recording head 44 of six colors and six rows, and Fig. 3(b) shows a bottom view of the carriage 42 including a recording head 44 of four colors and six rows. As shown in Fig. 3(a) and 3(b), the recording head 44 includes a plurality of arrays of ejection holes along the main scanning direction respectively corresponding to a plurality of colors.

[0029]

For example, the recording head 44 in Fig. 3(a) includes ejection hole arrays 112A to 112F respectively corresponding to six colors, i.e. BLACK, CYAN, LIGHT CYAN, MAGENTA, LIGHT MAGENTA and YELLOW. In addition, the recording head 44 in Fig. 3(b) includes ejection hole arrays 112A to 112F corresponding to four colors, i.e. BLACK, CYAN, MAGENTA and YELLOW.

[0030]

The intervals of each of the ejection hole arrays 112A to 112F in Fig. 3(a) are, e.g. 2.82mm, 8.47mm, 2.82mm, 8.47mm and 2.82mm from the left. In addition, the height of each row is 9.95mm. The arrangement intervals of the ejection hole arrays 112A to 112F and the height of each row are not limited to the examples shown in Fig. 3(a), and may be other arrangement interval.

[0031]

Fig. 4 shows an example of the deviation of a plurality of ejection holes 112 in a sub-scanning direction. Fig. 4(a) shows the bottom of the carriage 42. As shown in Fig. 4(a), the carriage 42 might have a tilt of θ_1 against the longitudinal direction of the guide 48 due to a bad condition, looseness or the like of fitting to the guide 48. Because of the tilt, each of the ejection holes 112 deviates in the sub-scanning direction, so that the image recorded on the material to be recorded 11 deviates.

[0032]

Fig. 4(b) shows an example of the deviation in the sub-scanning direction of a plurality of ejection holes 112 having the recording head 44 shown in Fig. 4(a). In Fig. 4(b) each of the ejection hole arrays 112A to 112F is shown as solid lines. The carriage 42 shown in Fig. 4(b) is fitted with the guide 48 to have a tilt of approximately 0 degree, 51 minutes and 58 seconds against the longitudinal direction of the guide 48. In case of the recording head 44 shown in Fig. 4(b), the distance between the ejection hole array 112A, the most left one, and the ejection hole array 112F, the most right one, is 25.4mm. The distance between the lowest ejection hole of the ejection hole array 112F, the most right one, and the ejection hole array 112A, the most left one, in the sub-scanning direction is approximately 66 μ m.

[0033]

Fig. 4(c) shows image data "A" recorded on the material to be recorded 11 after scanning of the carriage 42 shown in Fig. 4(a) and 4(b). As shown in Fig. 4(b), the ejection hole array 112F is positioned to be higher than the ejection hole array 112B in a direction opposite to the sub-scanning direction by 59 μ m. Therefore, as shown in Fig. 4(c), the image "A" formed of the ink ejected from the ejection hole array 112F is positioned to be higher than the image "A" formed of the ink ejected from the ejection hole array 112B. Therefore, the image "A", which is supposed to be recorded as one letter, is recorded as two letters in which the image deviates in the sub-scanning direction. Particularly, as shown in Fig. 3(a) and 3(b), since the ejection holes 112B and 112F eject ink of colors different from each other, i.e. cyan and yellow or black and yellow, it is obvious that the image recorded on the material to be recorded deviates. Since the resolution of the naked eye is approximately 20 μ m, the deviation of the recording position shown in Fig. (c) can be recognized to the naked eye.

[0034]

Fig. 5 shows a correction method of image data according to the present embodiment. In the present embodiment, each of the images with various colors is shifted in advance, and the image

data is shifted. As shown in Fig. 4(c), the image "A" formed of the ink ejected from the ejection hole array 112F is positioned to be higher than the image "A" formed of the ink ejected from the ejection hole array 112B. Accordingly, as shown in Fig. 5(a), the image "A" to be formed of the ink dots ejected from the ejection hole array 112F is corrected by shifting the position downwards as much as 2 dots in the sub-scanning direction in advance. In addition, as shown in Fig. 5(b), the image "A" to be formed of the ink ejected from the ejection hole array 112B is not corrected. In other words, the image data corresponding to each of the ejection holes 112 is corrected in a direction opposite to the deviation of the ejection holes 112 as much as each of the deviations of the ejection holes 112 in the sub-scanning direction caused by the tilt of the carriage 42.

[0035]

The amount of the deviation of each of the ejection hole arrays 112A to 112F in the sub-scanning direction shown in Fig. 4(b) is measured in the factory at the time of the shipment of the inkjet type recording apparatus. The correction amount of the image data is calculated based on the amount of the measured deviation, and stored into the correction amount storing unit 420 in advance. The correction amount of the image data can be shifted per one dot. The value of one dot is $1/720$ inch, $1/1440$ inch or the like. However, the value of one dot may be adjusted according to the resolution of the inkjet type recording apparatus. Since $1/720$ inch is approximately $35\mu\text{m}$ and the resolution of the naked eye is about $20\mu\text{m}$ to $30\mu\text{m}$, the image can be corrected to the extent that it cannot be recognized to the naked eye by shifting the image by $1/720$ inch. Further, since $1/1440$ inch is approximately $17.5\mu\text{m}$, the image can be corrected to even further extent that it cannot be recognized to the naked eye compared with $1/720$ inch.

[0036]

Fig. 6 shows the image resulting from combining each color before and after a correction. In case of using the recording head 44 of 6 colors and 6 rows shown in Fig. 3(a), in the image resulting

from combining each color before the correction shown as the left one in Fig. 6, the image "A" formed of the ink ejected from the ejection hole array 112B and the image "A" formed of the ink ejected from the ejection hole array 112F are positioned uniformly in the sub-scanning direction. On the other hand, in the image resulting from combining each color after the correction shown as the right one in Fig. 6, the image "A" formed of the ink ejected from the ejection hole array 112F is corrected to be shifted in the sub-scanning direction as much as 2 dots downwardly than the image "A" formed of the ink ejected from the ejection hole array 112B as shown in Fig. 5(a) and 5(b). Therefore, if the corrected image is recorded on the material 11 by using the carriage 42 normally fitted with the guide 48, two letters of the image "A" will be recorded while one is shifted against the other in the sub-scanning direction.

[0037]

However, if the corrected image is recorded on the material 11 by using the carriage 42 fitted with the guide 48 while it is tilted, since the image is shifted in advance as much as the deviation amount of the ejection holes 112 in the sub-scanning direction, in contrast that two letters are recorded on the material 11 while one is shifted against the other in the sub-scanning direction before the correction, one letter of "A", which is supposed to be shown on the material to be recorded 11, is recorded.

[0038]

In this way, the inkjet type recording apparatus according to the present embodiment shifts the image to be recorded on the material 11 based on the amount of the deviation of a plurality of ejection holes 112 in the sub-scanning direction. Therefore, even if the carriage 42 is fitted with the guide 48 while it is tilted, the image can be recorded on the material to be recorded 11 in the shape supposed to be recorded without adjusting the carriage 42 mechanically.

[0039]

Figs. 7 to 9 show an example of a method for measure the

amount of the deviation of a plurality of ejection holes 112 in the sub-scanning direction according to the present embodiment. Fig. 7(a) shows a state that the carriage 42 is fitted with the guide 48 normally. In the present embodiment, to measure the amount of the deviation of the ejection holes 112 in the sub-scanning direction, the ink dots are recorded on the material to be recorded 11 by ejecting ink from at least two ejection holes most distanced from each other in the main scanning direction among a plurality of ejection holes 112. For example, at least one of a pair of ejection hole arrays, i.e. a first ejection hole 112G from the top of the most left ejection hole array 112A and a second ejection hole 112J from the top of the most right ejection hole array 112F or a pair of ejection hole arrays, i.e. a lowest ejection hole 112I of the most left ejection hole array 112A and a fourth ejection hole 112K of the most right ejection hole array 112F is used. The reason why a pair of ejection holes most distanced from each other in the main scanning direction are used is because the amount of deviation of the ejection holes 112 in the sub-scanning direction is largest as shown in Fig. 4(b). Therefore, the amount of deviation can be exactly measured.

[0040]

The amounts of deviation of other ejection holes 112 except the two ejection holes distanced from each other in the main scanning direction can be obtained by dividing the amount of deviation of the two ejection holes distanced from each other in the main scanning direction in proportion to the arrangement interval of each ejection holes 112 in regard to the recording head 44 shown in Fig. 3(a).

[0041]

In case of Fig. 7(a), the first, third and fifth ejection holes 112G, 112H and 112I from the top of the most left ejection hole array 112A surrounded by a broken line and the second and fourth ejection holes 112J and 112K from the top of the most right ejection hole array 112F surrounded by a broken line are used. Since the distance to be measured becomes large by making the numbers

1, 3 and 5 of the used ejection holes of the most left ejection hole array 112A and the numbers 2 and 4 of the used ejection holes of the most right ejection hole array 112F different, the amount of deviation of the ejection holes 112 in the sub-scanning direction can be easily measured.

[0042]

In addition, as shown in Fig. 7(a), each of the ejection holes 112G to 112K is arranged on the recording head 44 in order that if the interval between the ejection holes 112G and 112H in the sub-scanning direction is defined as d , the interval between the ejection holes 112G and 112J in the sub-scanning direction becomes $d/2$, the interval between the ejection holes 112H and 112I in the sub-scanning direction becomes d and the interval between the ejection holes 112I and 112K in the sub-scanning direction becomes $d/2$.

[0043]

Fig. 7(b) shows the loci drawn by each of the ejection holes 112G to 112K when the carriage 42 moves to the right, i.e. through the forward path in the main scanning direction along the guide 48, and Fig. 7(c) shows the image formed of the ink ejected on the material to be recorded 11 when the carriage 42 performs a scanning operation as shown in Fig. 7(b) while ejecting ink from the ejection holes 112G to 112K. Since the carriage 42 is normally fitted with the guide 48, as shown in Fig. 7(b), the interval y_1 between the loci drawn by the ejection holes 112G and 112J in the sub-scanning direction is $d/2$ and the interval y_2 between the loci drawn by the ejection holes 112I and 112K in the sub-scanning direction is $d/2$.

[0044]

Therefore, as shown in Fig. 7(c), the interval y_1 in the sub-scanning direction between a line formed by the ink ejected from the ejection hole 112G and recorded on the material to be recorded 11 and a line formed by the ink ejected from the ejection hole 112J and recorded on the material to be recorded 11 is $d/2$, and the interval y_2 in the sub-scanning direction between a line

formed by the ink ejected from the ejection hole 112I and recorded on the material to be recorded 11 and a line formed by the ink ejected from the ejection hole 112K and recorded on the material to be recorded 11 is $d/2$. In other words, if the carriage 42 is normally fitted with the guide 48, the intervals y_1 and y_2 in the sub-scanning direction between lines formed by the ink recorded on the material to be recorded 11 from each of the ejection holes 112G to 112K become $d/2$. Accordingly, if the values resulting from measuring the intervals y_1 and y_2 are not equal to $d/2$, it is found that the carriage 42 is not normally fitted with the guide 48.

[0045]

Fig. 8(a) shows a carriage 42 fitted with the guide 48 while the left end of the carriage 42 is tilted in the sub-scanning direction. The carriage 42 is attached to have a tilt of θ_1 against the longitudinal direction of the guide 48. Fig. 8(b) shows the loci drawn by each of the ejection holes 112G to 112K when the carriage 42 shown in Fig. 8(a) moves to the right, i.e. through the forward path in the main scanning direction along the guide 48, and Fig. 8(c) shows the image formed of the ink ejected on the material to be recorded 11 when the carriage 42 performs a scanning operation as shown in Fig. 8(b) while ejecting ink from the ejection holes 112G to 112K. As shown in Fig. 8(b), the interval y_1 between the loci drawn by the ejection holes 112G and 112J in the sub-scanning direction is larger than $d/2$ and the interval y_2 between the loci drawn by the ejection holes 112I and 112K in the sub-scanning direction is smaller than $d/2$.

[0046]

Therefore, as shown in Fig. 8(c), the interval y_1 in the sub-scanning direction between a line formed by the ink ejected from the ejection hole 112G on the material to be recorded 11 and a line formed by the ink ejected from the ejection hole 112J on the material to be recorded 11 is larger than $d/2$. And, the interval y_2 in the sub-scanning direction between a line formed by the ink ejected from the ejection hole 112I on the material to be recorded 11 and a line formed by the ink ejected from the ejection hole

112K on the material to be recorded 11 is smaller than $d/2$. In addition, since the amount of the deviation of the ejection hole array in the direction in which the carriage 42 is tilted to the guide 48 and in the sub-scanning direction can be obtained from the intervals y_1 and y_2 , the correction amount of the image in regard to each of a plurality of ejection holes can be calculated based on the obtained amount of the deviation.

[0047]

Fig. 9(a) shows a carriage 42 fitted with the guide 48 while the right end of the carriage 42 is tilted in the sub-scanning direction. The carriage 42 is attached to have a tilt of θ_2 against the longitudinal direction of the guide 48. Fig. 9(b) shows the loci drawn by each of the ejection holes 112G to 112K when the carriage 42 shown in Fig. 9(a) moves to the right, i.e. through the forward path in the main scanning direction along the guide 48, and Fig. 9(c) shows the image formed of the ink ejected on the material to be recorded 11 when the carriage 42 performs a scanning operation as shown in Fig. 9(b) while ejecting ink from the ejection holes 112G to 112K. As shown in Fig. 9(b), the interval y_1 between the loci drawn by the ejection holes 112G and 112J in the sub-scanning direction is smaller than $d/2$ and the interval y_2 between the loci drawn by the ejection holes 112I and 112K in the sub-scanning direction is larger than $d/2$.

[0048]

Therefore, as shown in Fig. 9(c), the interval y_1 in the sub-scanning direction between a line formed by the ink ejected from the ejection hole 112G on the material to be recorded 11 and a line formed by the ink ejected from the ejection hole 112J on the material to be recorded 11 is smaller than $d/2$. And, the interval y_2 in the sub-scanning direction between a line formed by the ink ejected from the ejection hole 112I on the material to be recorded 11 and a line formed by the ink ejected from the ejection hole 112K on the material to be recorded 11 is larger than $d/2$. Therefore, if the values resulting from measuring the intervals y_1 and y_2 are not equal to $d/2$, it is found that the carriage 42 is not normally

fitted with the guide 48.

[0049]

In addition, the interval y_1 is larger than the interval y_2 in case of Fig. 8, and the interval y_1 is small than the interval y_2 in case of Fig. 9. Therefore, if the directions in which the carriage 42 is tilted to the guide 48 are different as shown in fig. 8 and 9, the values of the intervals y_1 and y_2 are different. Accordingly, the direction in which the carriage 42 is tilted to the guide 48 can be known from the intervals y_1 and y_2 . Further, since the amount of deviation of ejection holes 112 in the sub-scanning direction can be obtained from the intervals y_1 and y_2 , the correction amount of the image in regard to each of a plurality of ejection holes can be calculated based on the obtained amount of the deviation.

[0050]

Moreover, the intervals y_1 and y_2 are changed corresponding to the tilt θ_1 or θ_2 of the carriage 42 to the guide 48. However, since the intervals y_1 and y_2 are not $d/2$ as long as the carriage 42 is not normally fitted with the guide 48, it can be judged whether the carriage 42 is tilted to the guide 48 by measuring the intervals y_1 and y_2 .

[0051]

In addition, alternatively, the amount of the deviation of ejection holes in the sub-scanning direction may be measured based on the image formed on the material to be recorded 11 performed by the ink ejected from the ejection holes 112 of other ejection holes except the ejection holes 112G and 112J or 112I and 112K of the two ejection holes most distanced from each other. For example, the amount of the deviation of ejection holes 112 in the sub-scanning direction may be measured based on the image formed on the material to be recorded 11 performed by the ink ejected from the ejection holes 112 of one of the ejection hole arrays 112B to 112E existing between the two ejection holes most distanced from each other.

[0052]

In calculating the correction amount of the image by obtaining

the amount of the deviation in the sub-scanning direction of the ejection hole arrays 112B to 112E existing between the two ejection hole arrays 112A and 112F by dividing the amount of the deviation in the sub-scanning direction of the two ejection hole arrays 112A and 112F most distanced from each other in the main scanning direction in proportion to the arrangement relation of each ejection hole array in regard to the recording head 44, it might be difficult to judge the correction amount of the image of the ejection hole arrays 112B to 112E even by the amount of the deviation in the sub-scanning direction of the two ejection hole arrays 112A and 112F.

[0053]

For example, if the amount of deviation of the two ejection hole arrays 112A and 112F in the sub-scanning direction is 2.6 dots, it is determined as a shift of 3 dots. At this time, if the value obtained by dividing in proportion to the deviation amount of the ejection hole array 112D is 1.5, whether the deviation of the image is corrected might not be guaranteed simply by shifting the ejection hole array 112D by 2 dots. Since the amount of deviation in the sub-scanning direction of the two ejection hole arrays 112A and 112F most distanced from each other is 2.6 dots, the deviation of the image might be corrected by shifting the ejection hole array 112D by 1 dot. Accordingly, by further measuring the amount of the deviation in the sub-scanning direction of the ejection hole arrays 112B to 112E between the two ejection hole arrays 112A and 112F, the correction amount of the image corresponding to the ejection hole arrays 112B to 112E can be calculated accurately.

[0054]

In addition, if the carriage 42 is not normally fitted with the guide 48, the carriage 42 rattles during moving. Therefore, the tilt of the carriage 42 to the guide 48 is changed both when the carriage 42 moves to the right, i.e. along the forward path in the main scanning direction and when the carriage 42 moves to the left, i.e. along the backward path in the main scanning direction. For example, when the carriage 42 moves along the forward path

in the main scanning direction, the right end of the carriage 42 is tilted in the sub-scanning direction as shown in Fig. 8, and when the carriage 42 moves along the backward path in the main scanning direction, the left end of the carriage 42 is tilted in the sub-scanning direction as shown in Fig. 9. If the ink is ejected from the recording head 44 while the carriage 42 with looseness performs scanning operations in both directions along the forward and backward paths in the main scanning direction, the deviation of the image might be considerable.

[0055]

Accordingly, the image may be shifted in advance based on an intermediate value between the amount of the deviation of the image in the sub-scanning direction in case the recording head 44 performs scanning along the forward path in the main scanning direction and the amount of the deviation of the image in the sub-scanning direction in case the recording head 44 performs scanning along the backward path in the main scanning direction. Therefore, it is possible to correct the deviation of the image even when recording is performed in both directions, i.e. the forward and backward paths in the main scanning direction.

[0056]

In addition, alternatively, the amount of the deviation of the image in the sub-scanning direction in case the recording head 44 performs scanning along the forward path in the main scanning direction and the amount of the deviation of the image in the sub-scanning direction in case the recording head 44 performs scanning along the backward path in the main scanning direction may be measured separately, so that the image in regard to the forward path in the main scanning direction can be shifted in advance based on the amount of the deviation of the image in the sub-scanning direction in case the recording head 44 performs scanning along the forward path in the main scanning direction, while the image in regard to the backward path in the main scanning direction can be shifted in advance based on the amount of the deviation of the image in the sub-scanning direction in case the recording head

44 performs scanning along the backward path in the main scanning direction. In this case, it is possible to correct the deviation of the image in each direction of the forward and backward paths in the main scanning direction.

[0057]

In addition, alternatively, the ink may be ejected from two ejection holes ejecting two colors respectively as priority is given to a color whose density is highest among a plurality of ejection holes, so that the image to be recorded on the material in regard to each of the plurality of ejection holes can be shifted in advance based on the amount of the deviation of the ink ejected from the two ejection holes. For example, the ejection hole array 112B ejecting cyan whose density is high or the ejection hole array 112D ejecting magenta whose density is high and the ejection hole 112G ejecting black may be used. By using ink whose density is high, the visibility of the image recorded on the material 11 is increased, and thus it is possible to measure the amount of the deviation of the recording position of the ink dots easily.

[0058]

In this way, in the present embodiment, the ink from a plurality of ejection hole arrays 112A to 112F is ejected on the material to be recorded 11 in order that the colors of ink are different respectively, and the amount of the deviation of the ejection hole 112 in the sub-scanning direction is measured for each color of the ink dots. Therefore, by using the measured amount of deviation of the ejection hole 112, as shown in Fig. 5 and Fig. 6, the images of different colors are shifted respectively in advance, so that correction can be performed. Therefore, even if the carriage 42 is fitted with the guide 48 while it is tilted, the images can be recorded on the material to be recorded 11 in the shape supposed to be recorded without adjusting the carriage 42 mechanically.

[0059]

Fig. 10 is an example of the flowchart showing processes of a recording correction method according to the present embodiment. The recording correction method according to the

present embodiment includes a setting step S106 of setting the correction amount of the image to the inkjet type recording apparatus 10 in the factory or the like and a correction step S110 of correcting the image data during the use of the inkjet type recording apparatus 10.

[0060]

In the setting step S106, as described in Fig. 7 to 9, the ink is ejected from predetermined one of ejection holes 112 on the material to be recorded 11 based on the test data (S100), and the amount of the deviation in the sub-scanning direction of the image formed of the ink on the material to be recorded 11 is measured and the correction amount of the image is calculated (S102). Next, the calculated correction amount is stored into the correction amount storing unit 420 of the controlling unit 49 (S104). Next, the image data is corrected based on the correction amount based on the correction amount storing unit 420 of the inkjet type recording apparatus 10 and recorded on the material to be recorded 11 (S110).

[0061]

Fig. 11 shows the correction step S110 in detail. First, the image data supposed to be recorded on the material to be recorded 11 is generated (S112). Next, the color data of the pixel of the generated image data is separated for each color that the recording head 44 has (S114). Next, as described in Fig. 5 and Fig. 6, the image data is corrected based on the correction amount of the ejection holes 112 corresponding to each color (S116). Next, whether the process has been completed for all colors of the data is judged (S118). If the process has not yet been completed for all colors of the data (S118, No), the image data of the next color is corrected (S116).

[0062]

If the process has been completed for all colors of the data (S118, Yes), whether the process has been completed for the image data of one scanning portion of the carriage 42 is judged (S120). If the process has not yet been completed for the image data of

one scanning portion (S120, No), the data of the color of the next pixel is separated (S114). If the process has been completed for the image data of one scanning portion (S120, Yes), the correction data is outputted to the transferring unit 30 and the printing unit 40, and the corrected image data is recorded on the material to be recorded 11 (S122). Next, whether the recording has been completed on the material to be recorded 11 is judged (S124), if the recording has not yet been completed (S124, No), the color data of the next pixel is separated (S114). If the recording has been completed (S124, Yes), a process of, e.g. cleaning the recording head 44 is performed after recording is completed (S126). Therefore, by obtaining the correction amount of the image in regard to initial setting before shipment, the deviation of the image in the sub-scanning direction can be corrected during the use of a user. The process of correcting the image shown in Fig. 11 may be performed by the inkjet type recording apparatus 10.

[0063]

In addition, the process of correcting the image shown in Fig. 11 may be performed by a user with the information processing apparatus 300. If a user corrects the image by using the information processing apparatus 300, the information processing apparatus 300 acquires the correction amount stored in the inkjet type recording apparatus 10 and corrects the image data based on the computer program stored in the recording medium 700 or the like, and outputs the corrected image data to the inkjet type recording apparatus 10 in order to perform recording on the material to be recorded 11. Therefore, a user can corrects the image by using the information processing apparatus 300 if the looseness of the carriage 42 becomes large during the use of the inkjet type recording apparatus 10.

[0064]

As obvious from the description above, according to the present invention, it is possible to previously shift and correct each of the images in response to the amount of the deviation in the sub-scanning direction of each of the ejection holes 112. Thus,

even if the carriage 42 is fitted with the guide 48 while it is tilted, the image can be recorded on the material to be recorded 11 in the shape supposed to be recorded without adjusting the carriage 42 mechanically.

[0065]

Although the present invention has been described by way of an exemplary embodiment, it should be understood that those skilled in the art might make many changes and substitutions without departing from the spirit and the scope of the present invention, which is defined only by the appended claims.

[0066]

[Advantages of the Invention]

As obvious from the description above, according to the present invention, it is possible to correct the deviation of the image recorded on the material, which occurs due to the deviation of the recording head in the sub-scanning direction.

[BRIEF DESCRIPTION OF THE DRAWINGS]

Fig. 1 is a side view schematically showing the inner configuration of an inkjet type recording apparatus.

Fig. 2 shows an example of functional blocks of a controlling unit 49.

Fig. 3(a) and 3(b) are bottom views of a carriage 42 on which a recording head 44 is provided.

Fig. 4 shows an example of a deviation of a plurality of ejection holes 112 in a sub-scanning direction.

Fig. 5 shows a correction method of image data of this embodiment.

Fig. 6 shows an image resulting from combining both colors before and after a correction.

Fig. 7 shows an example of a method for measuring the deviation of a plurality of ejection holes 112 in a sub-scanning direction in this embodiment.

Fig. 8 shows an example of a method for measuring the deviation of a plurality of ejection holes 112 in a sub-scanning direction in this embodiment.

Fig. 9 shows an example of a method for measuring the deviation of a plurality of ejection holes 112 in a sub-scanning direction in this embodiment.

Fig. 10 shows an example of a flowchart illustrating processes of a recording correction method according to the present embodiment.

Fig. 11 shows processes of a correction step S110 in detail.

[List of the Elements]

10 inkjet type recording apparatus, 11 material to be recorded, 12 placement unit, 20 feeding unit, 24 separation pad, 26 driving shaft, 30 transferring unit, 32 transferring roller, 34 transfer driven roller, 40 printing unit, 44 recording head, 46 engaging part, 48 guide, 49 controlling unit, 50 discharging unit, 52 discharging roller, 54 discharge driven roller, 62 belt, 64 tensioner, 112 ejection hole, 300 information processing apparatus, 400 correction data outputting unit, 420 correction amount storing unit, 430 correcting unit, 440 image data storing unit, 450 correction data storing unit, 700 CD-ROM

[DOCUMENT] ABSTRACT

[ABSTRACT]

[OBJECT]

It is to correct the deviation of an image to be recorded on a material, which occurs due to the deviation of a recording head in a sub-scanning direction.

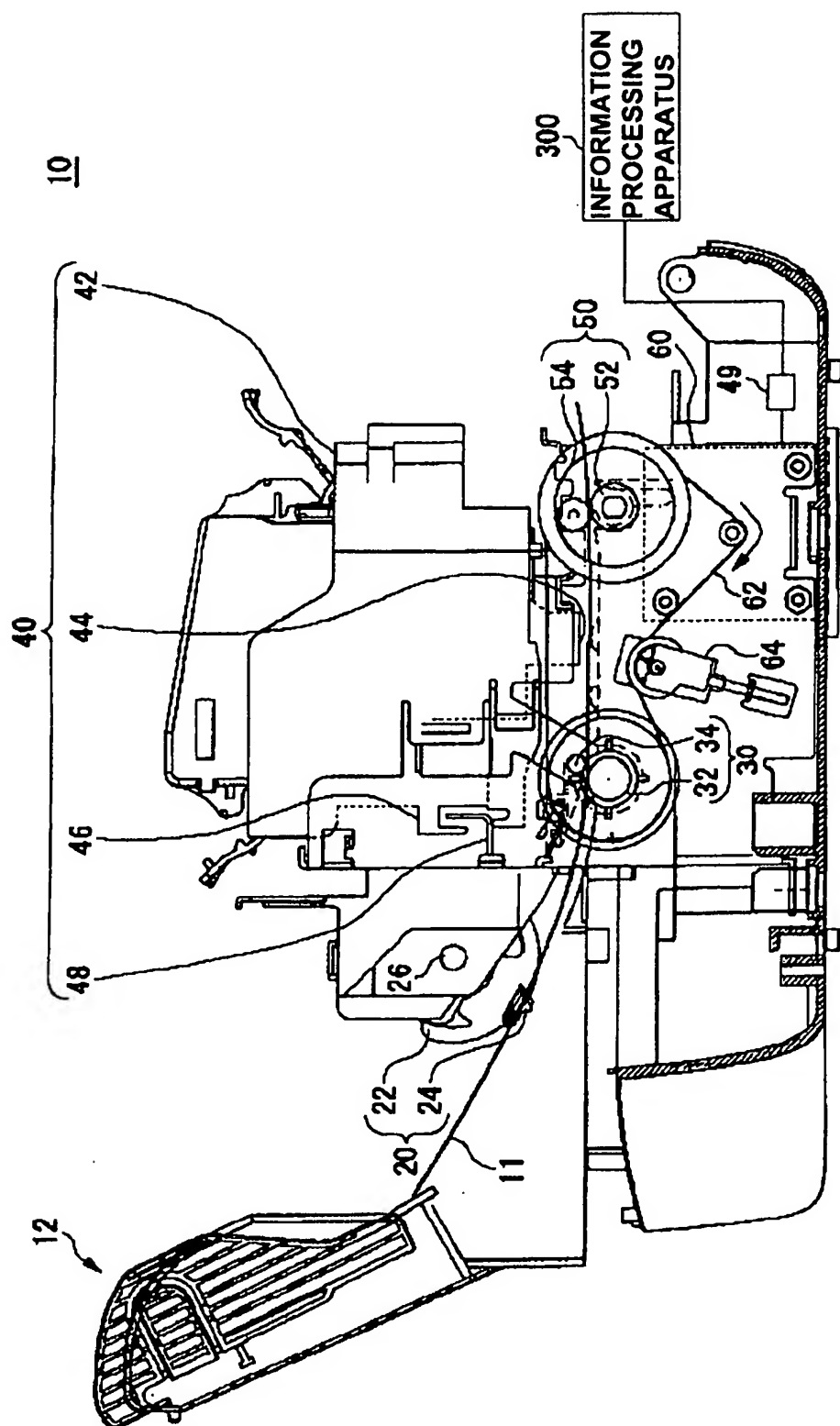
[MEANS FOR ACHIEVING THE OBJECT]

A recording correction method for correcting position deviation of a plurality of ejection holes in a sub-scanning direction crossing a main scanning direction, wherein an inkjet type recording apparatus performs recording on the material to be recorded by ejecting ink from the plurality of ejection holes while allowing a recording head, on which the plurality of ejection holes are arranged in the main scanning direction, to perform scanning along at least one of forward and backward paths in the main scanning direction, includes an ejection step of ejecting the ink from the plurality of ejection holes onto the material to be recorded, a measurement step of measuring an amount of deviation of ejected ink in the sub-scanning direction, and a correction step of previously shifting and correcting an image to be recorded on the material for each of the plurality of ejection holes based on the measured amount of deviation.

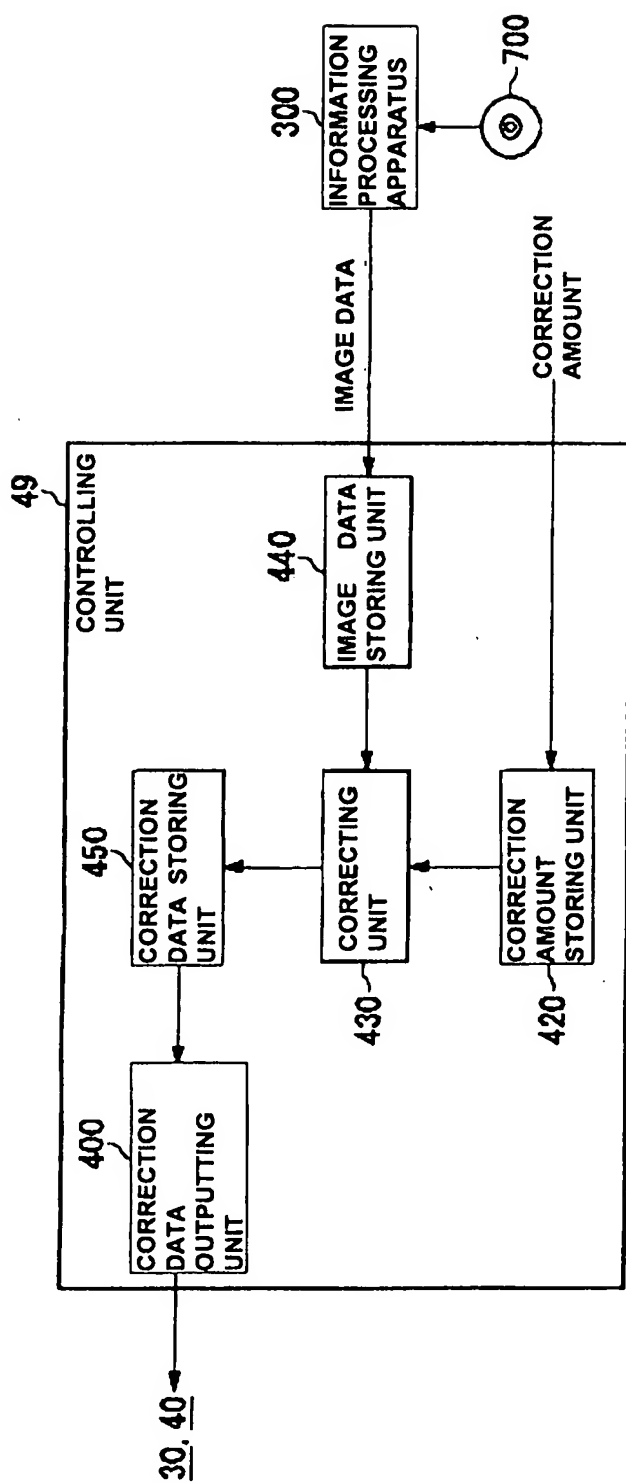
[SELECTED FIGURE]

Fig. 2

[Fig. 1]

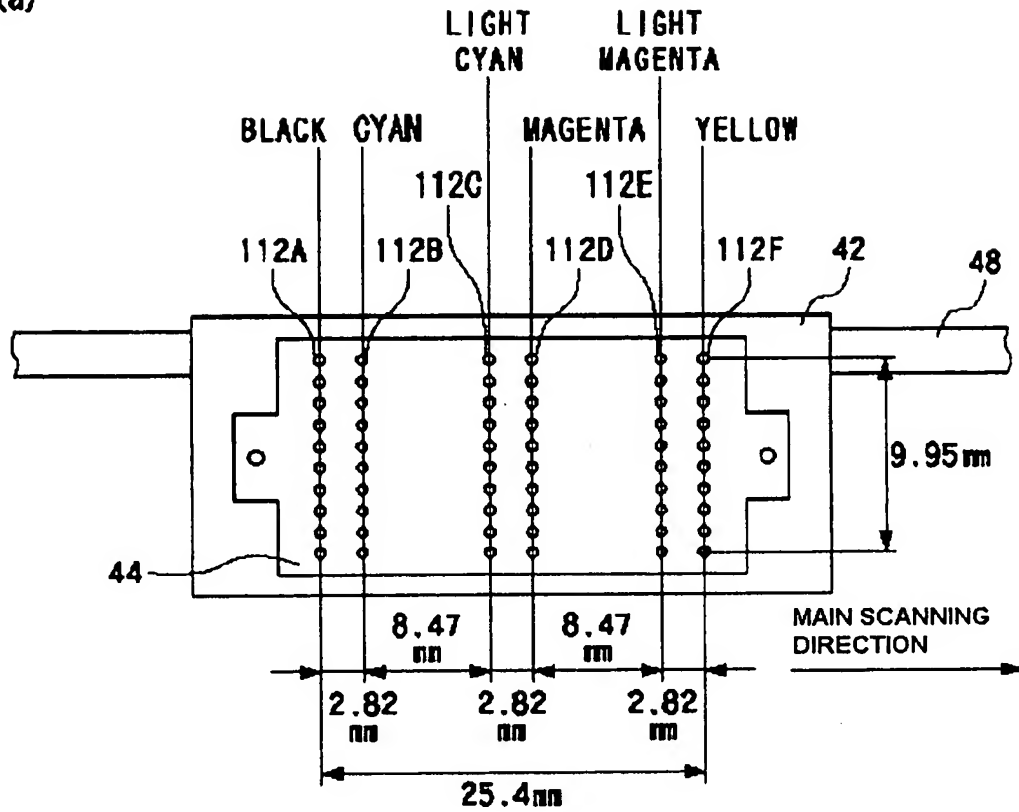


[Fig. 2]

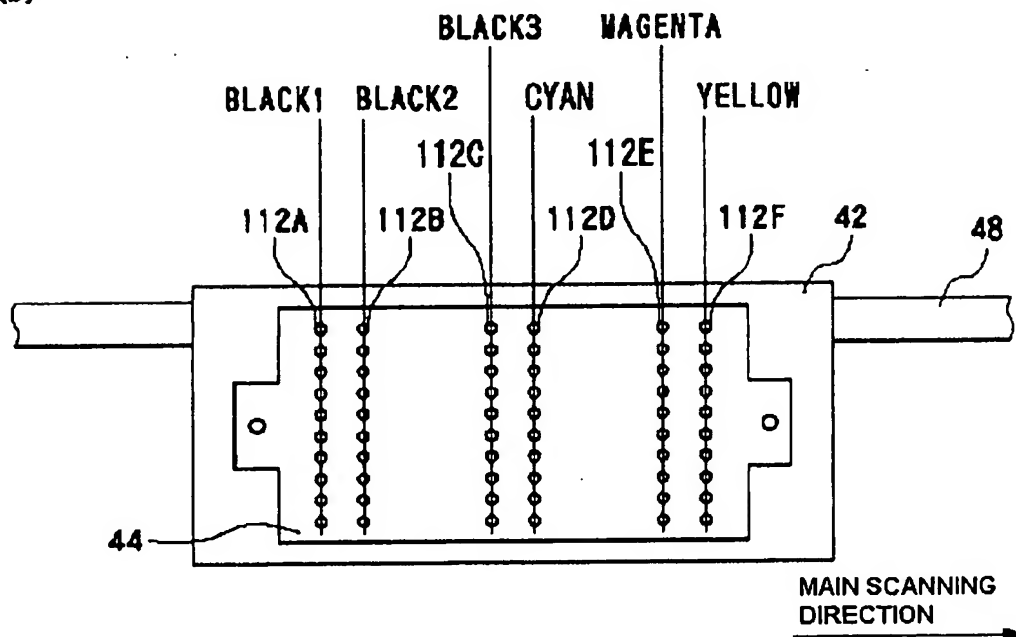


[Fig. 3]

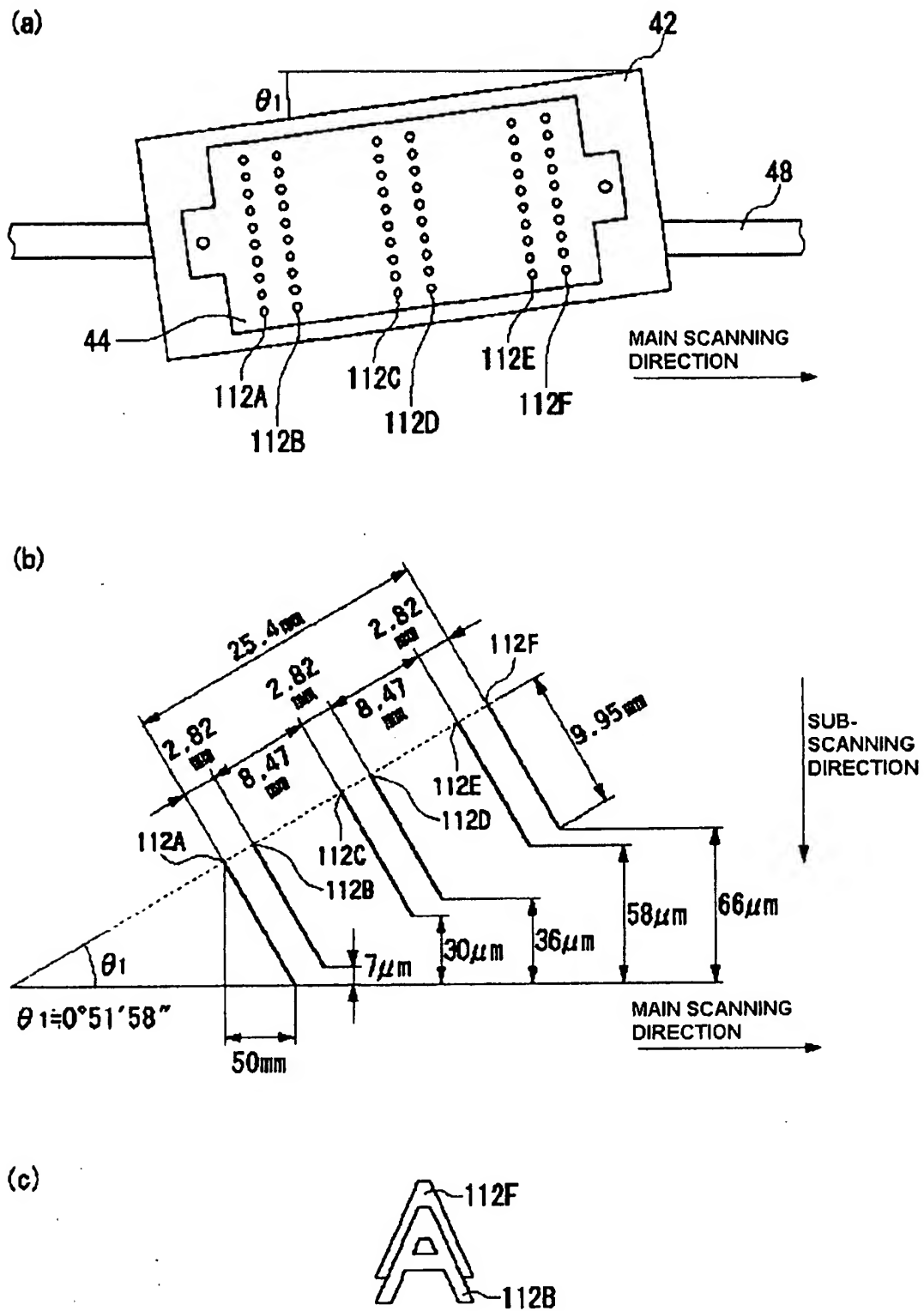
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(b)

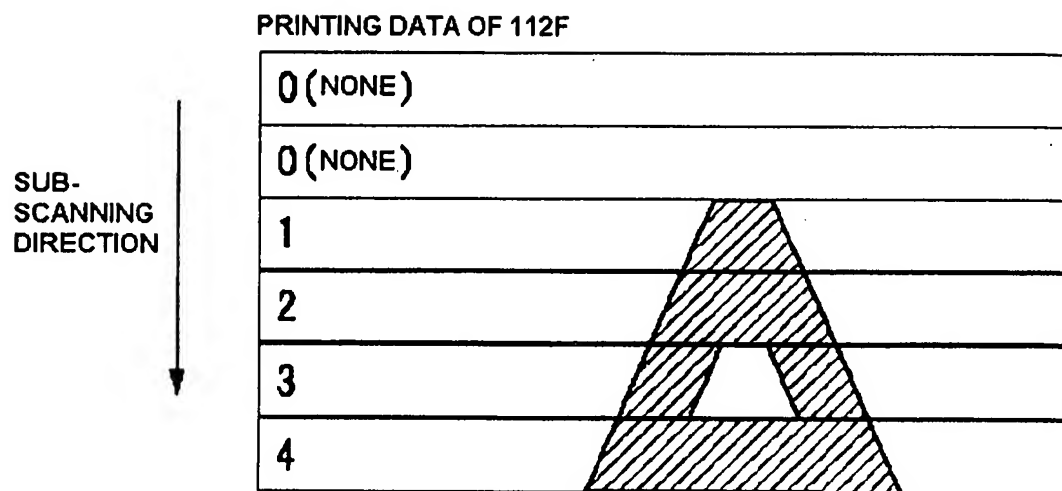


[Fig. 4]

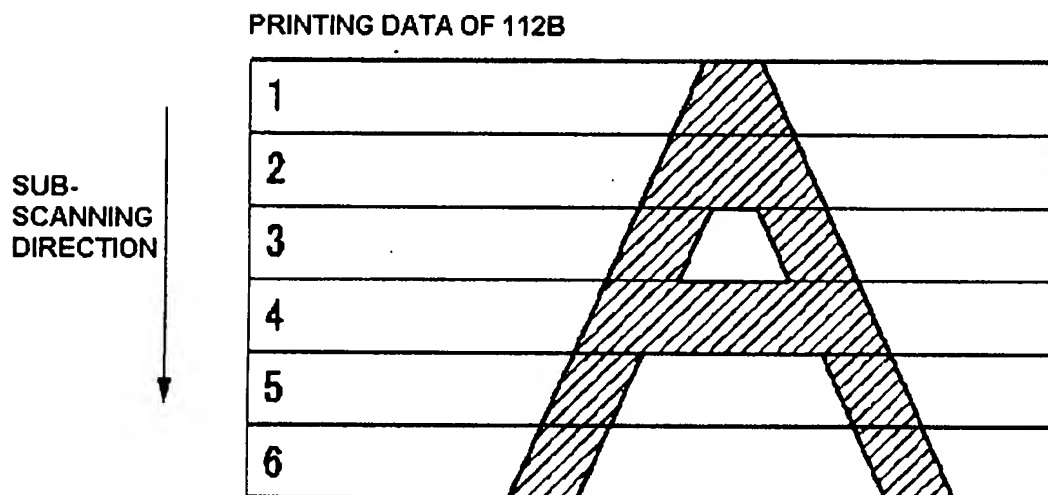


[Fig. 5]

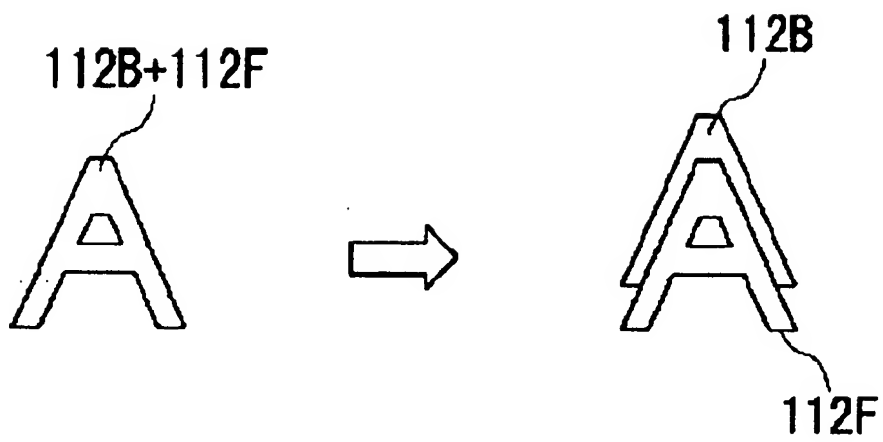
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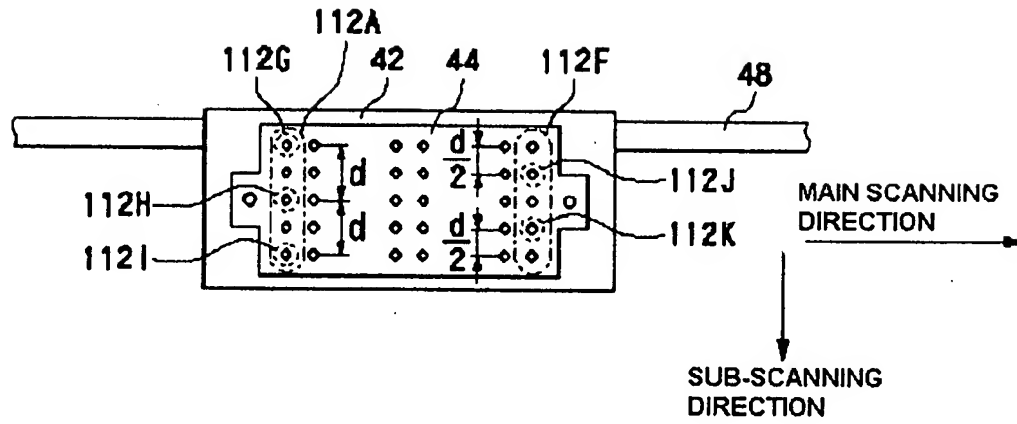


[Fig. 6]

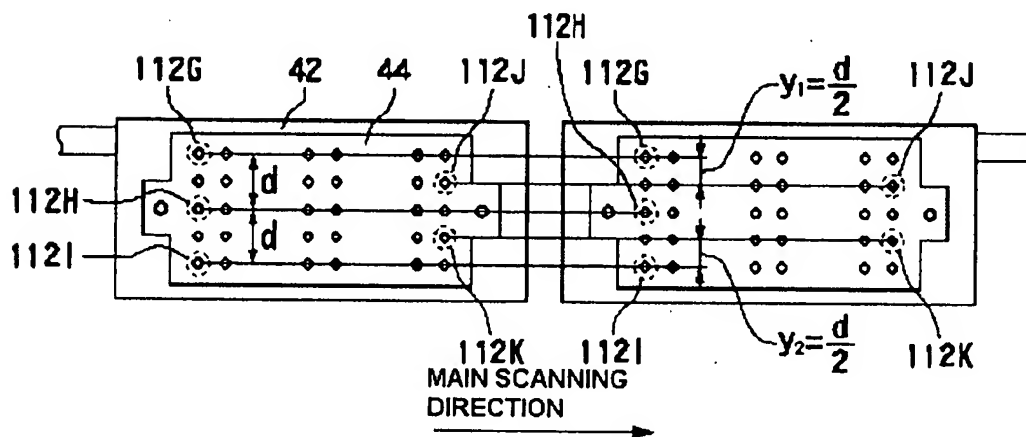


[Fig. 7]

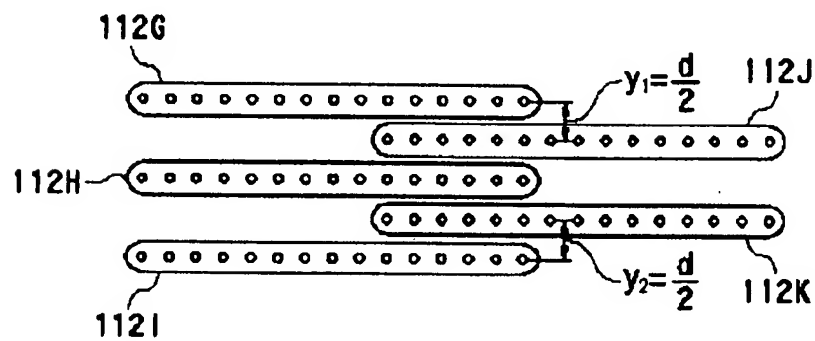
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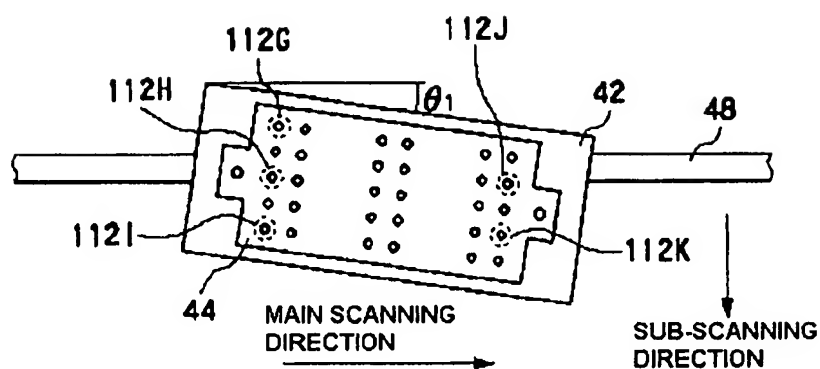


(c)

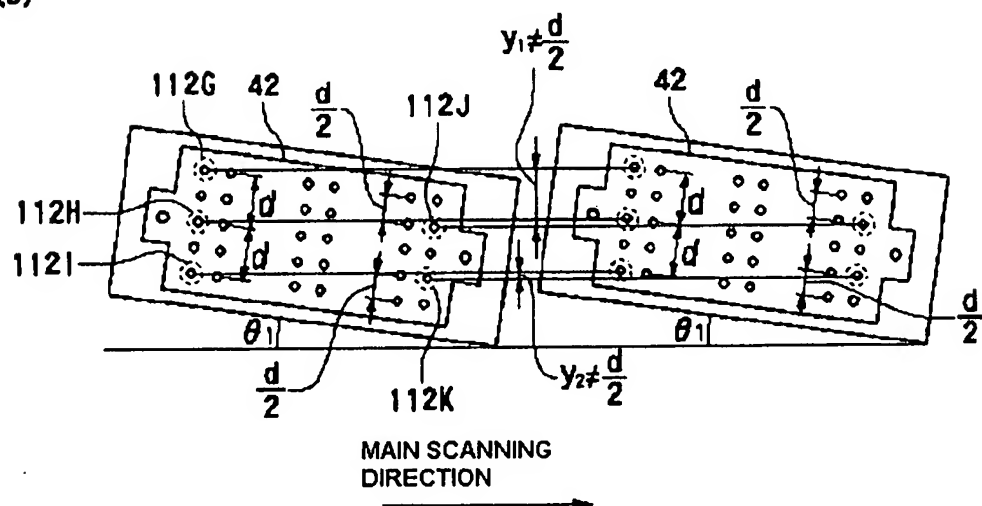


[Fig. 8]

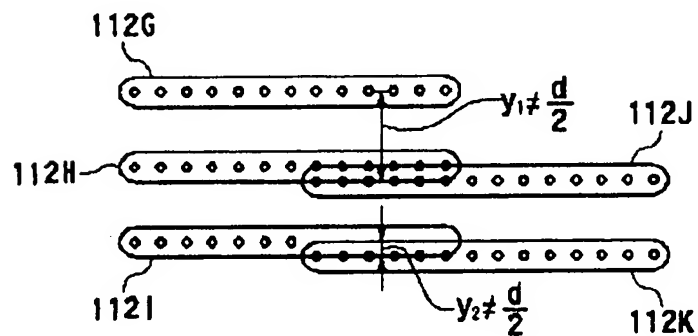
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(b)

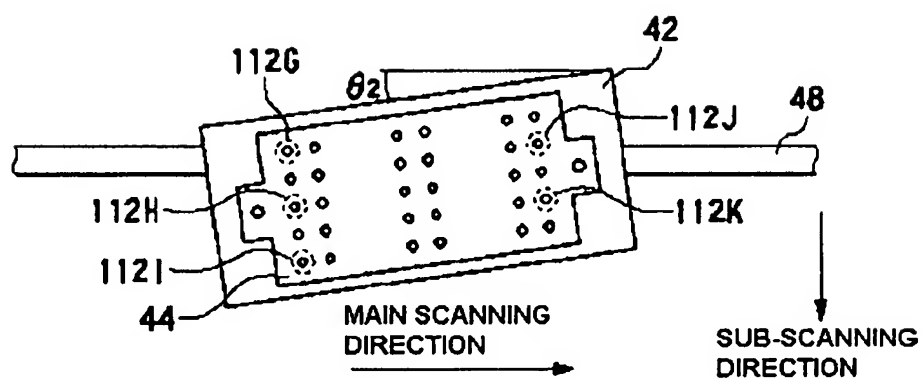


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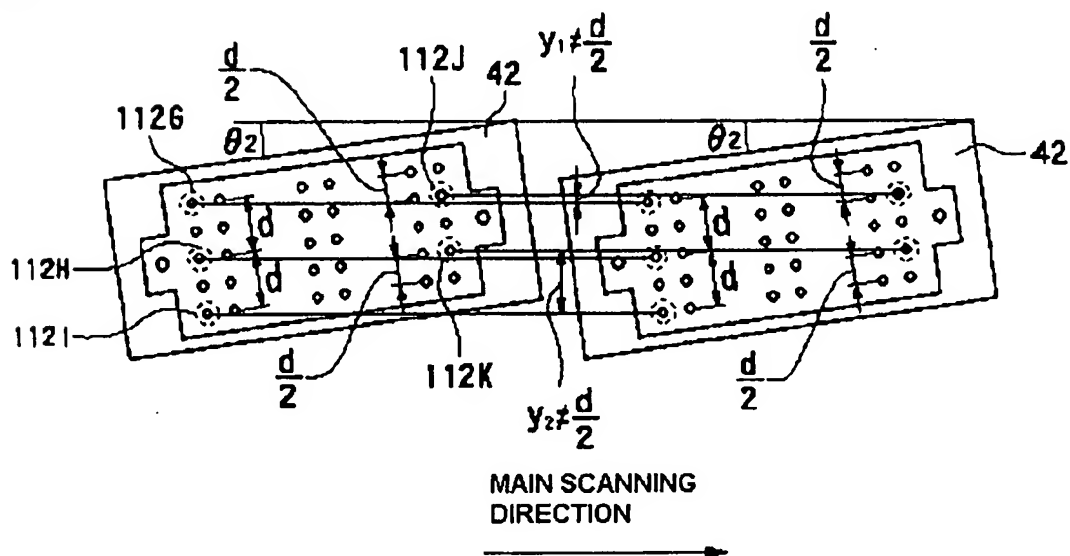


[Fig. 9]

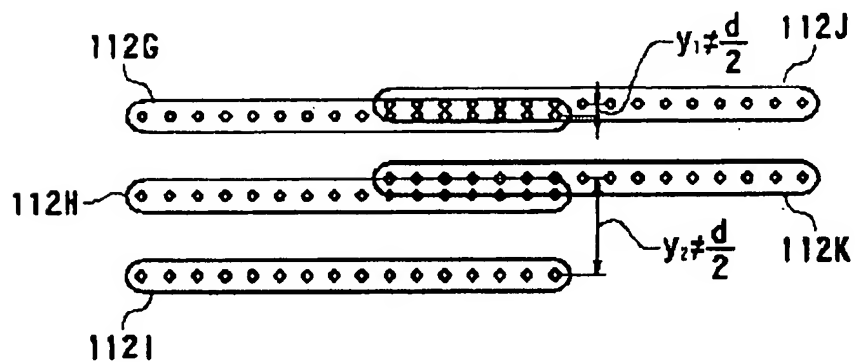
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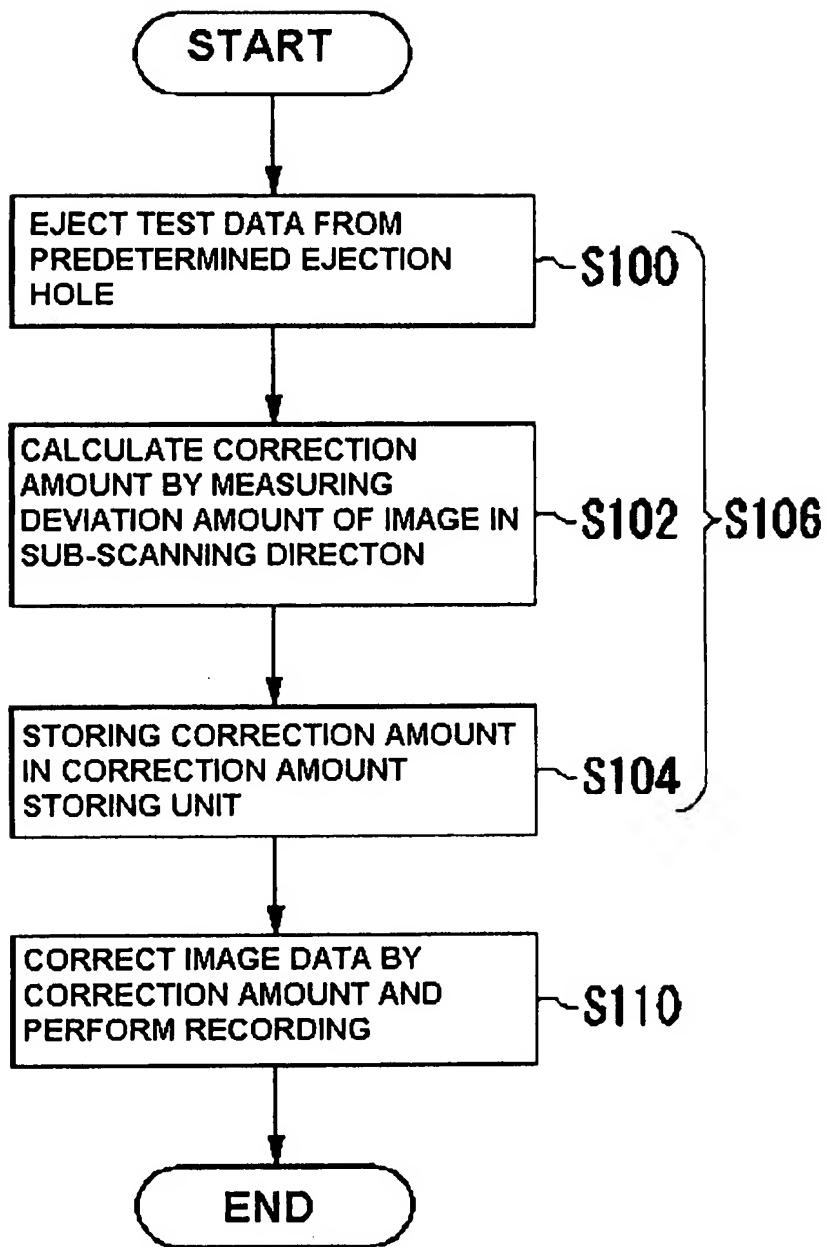
(b)



(c)



[Fig. 10]



[Fig. 11]

